Electrochemical analysis of irreversible behavior in silicon electrode for lithium ion battery.

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This study focuses on the mechanism of irreversible behavior in silicon electrode at various C-rates (0.1, 0.05, and 0.01 C-rate). An irreversible capacity of silicon electrode was examined by electrochemical performance. In order to confirm the irreversible capacity, silicon electrode/lithium foil half cells (2032 coin cell) were assembled in a dry room. When the amount of Li inserted into silicon electrode was 1 mol per 1mol of silicon, the discharge capacity of silicon electrode cell was estimated 953 mAh g^{-1} and charge capacity is 706 mAh g^{-1} in 1st cycle at 0.1 C-rate. The irreversible capacity of silicon electrode was 247 mAh g^{-1}. The silicon electrodes at 0.05 and 0.01 C-rate showed irreversible capacities of 318 mAh g^{-1}, and 437 mAh g^{-1}, respectively. The irreversible capacity of silicon electrode decreased at high C-rate. This might indicate more lithium ion was trapped in the amorphous silicon phase at low C-rate [1]. Also more solid electrolyte interphase layer was being produced at 0.01 C-rate. The SEI layer and silicon phase at each C-rate were observed by SEM, XRD and TEM.

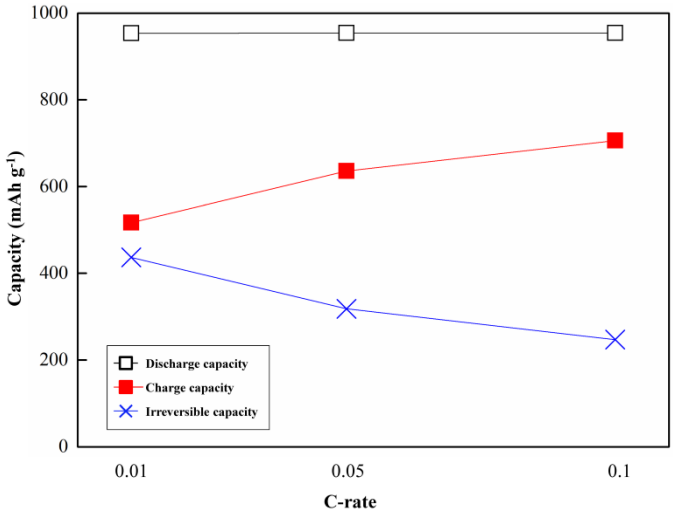

Figure 1. Voltage profiles after 1st cycle at a C-rate of 0.01, 0.05, and 0.1.

Reference

[1] M. N. Obrovac, L. J. Krause, J. Electrochem. Soc., 154(2), A103 (2007).